NASA

SECTION 22

PE TAL Target Line Entry QBAR Limit Expansion

DM42/M. Schottel

Background

- TAL PE Target Lines
  - Generated by DM44/M. Abadie and R. Proud
  - Targets for 348k ft and 0.8 deg flight path angle have been evaluated for QBAR constraint violations
    - Of the ascent desired target line altitudes 348k is the worse case for entry QBAR and entry heating (TSEP)
    - Lower target altitude (~338k) has also been suggested that doesn't violate TSEP body point and thermal math model limits but still does violate QBAR limits
      - However angle of attack evaluation criteria for TSEP validity exceeded in these cases – may require re-certification?
  - Runs include high and low inc TAL trajectories
    - MRN, BEN
    - High Inc only for ZZA
- QBAR data points
  - Generated using Monte Carlo STAMPS simulation
  - Represent 99.87% protection at each velocity point with 95% confidence

SODB QBAR LIMIT

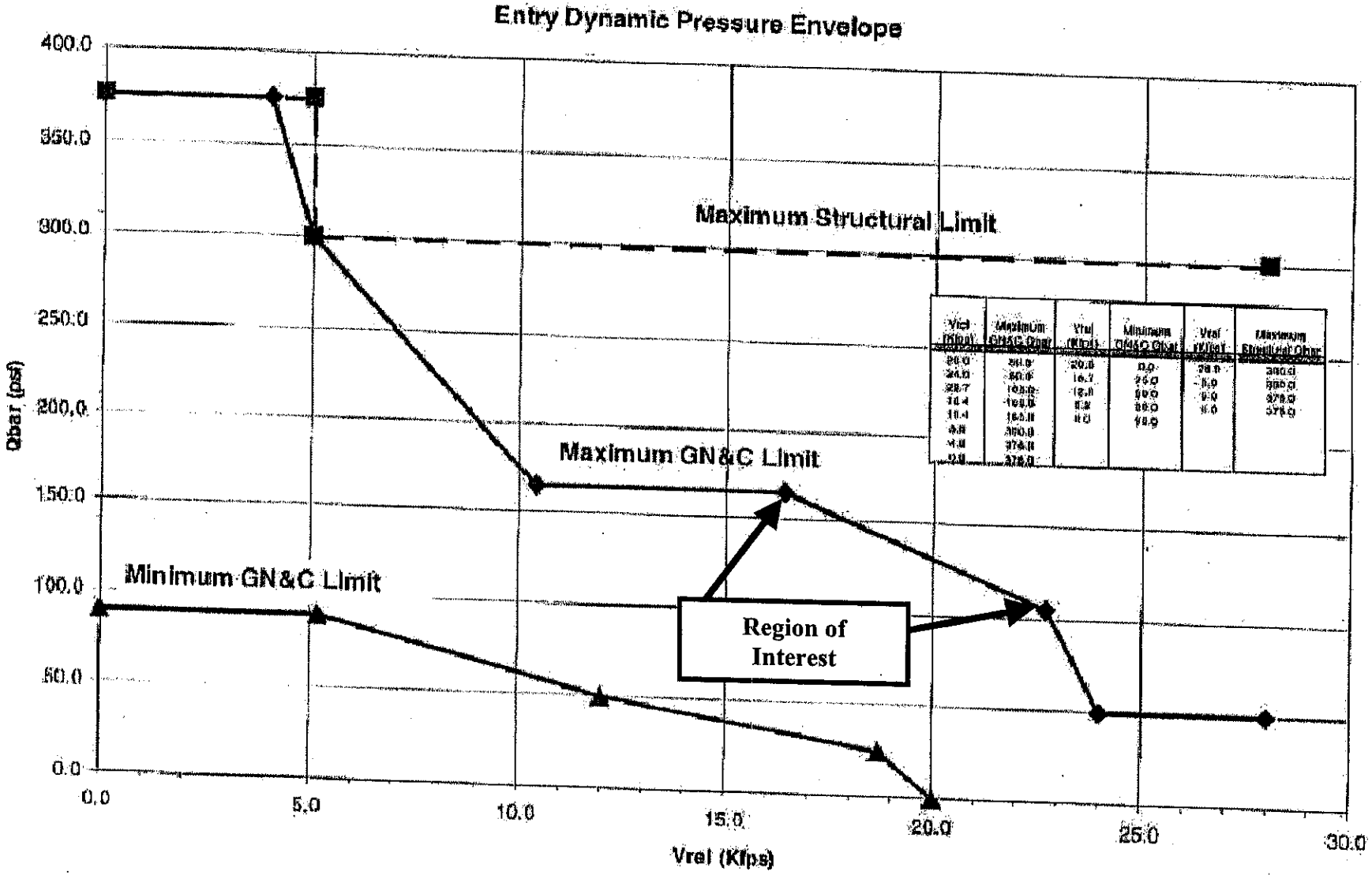
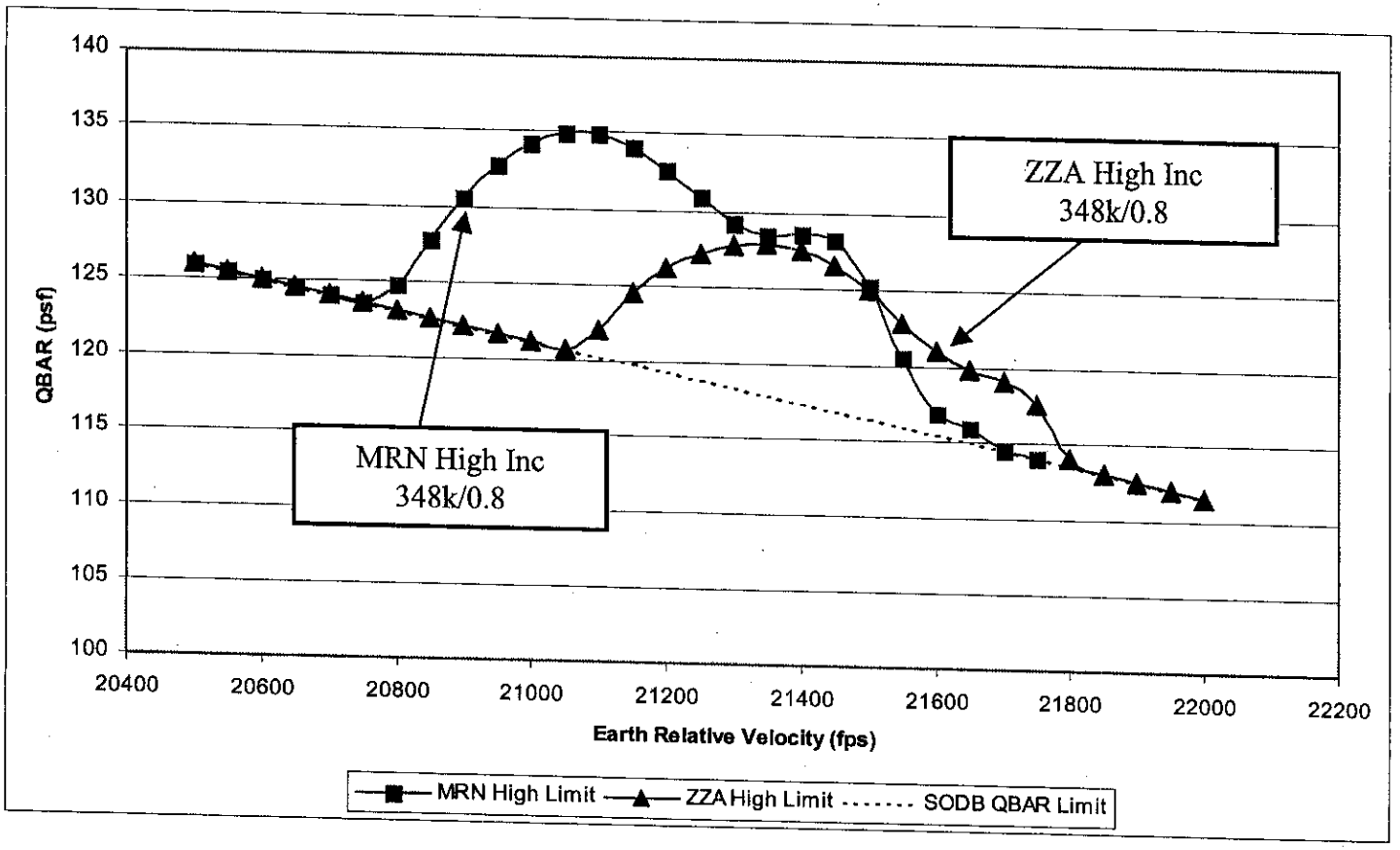


Figure 4.2.2-4 Entry Dynamic Pressure Boundaries
(Paragraph 4.2.2)

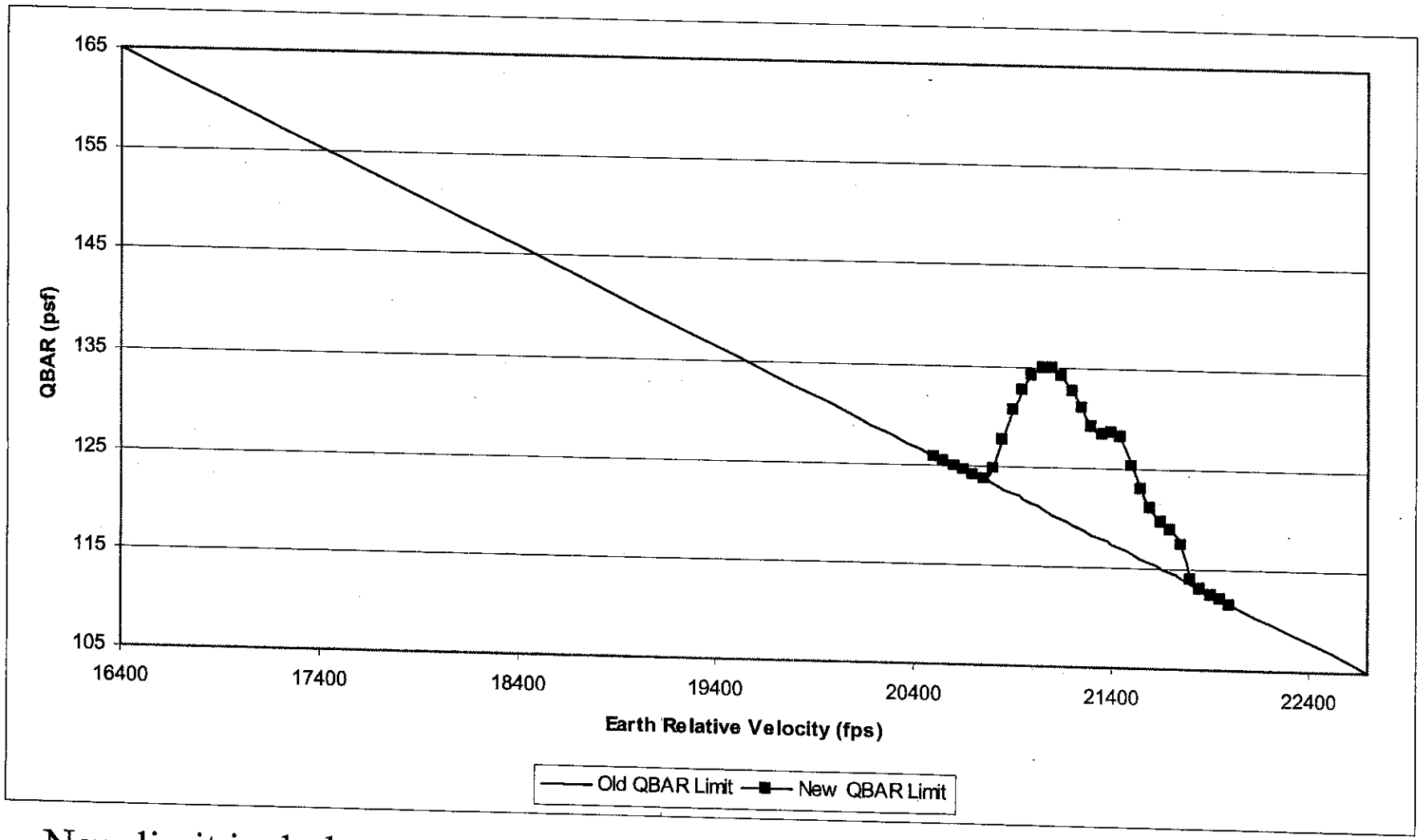
DM42/M. Schottel

QBAR Limit Violation Regions



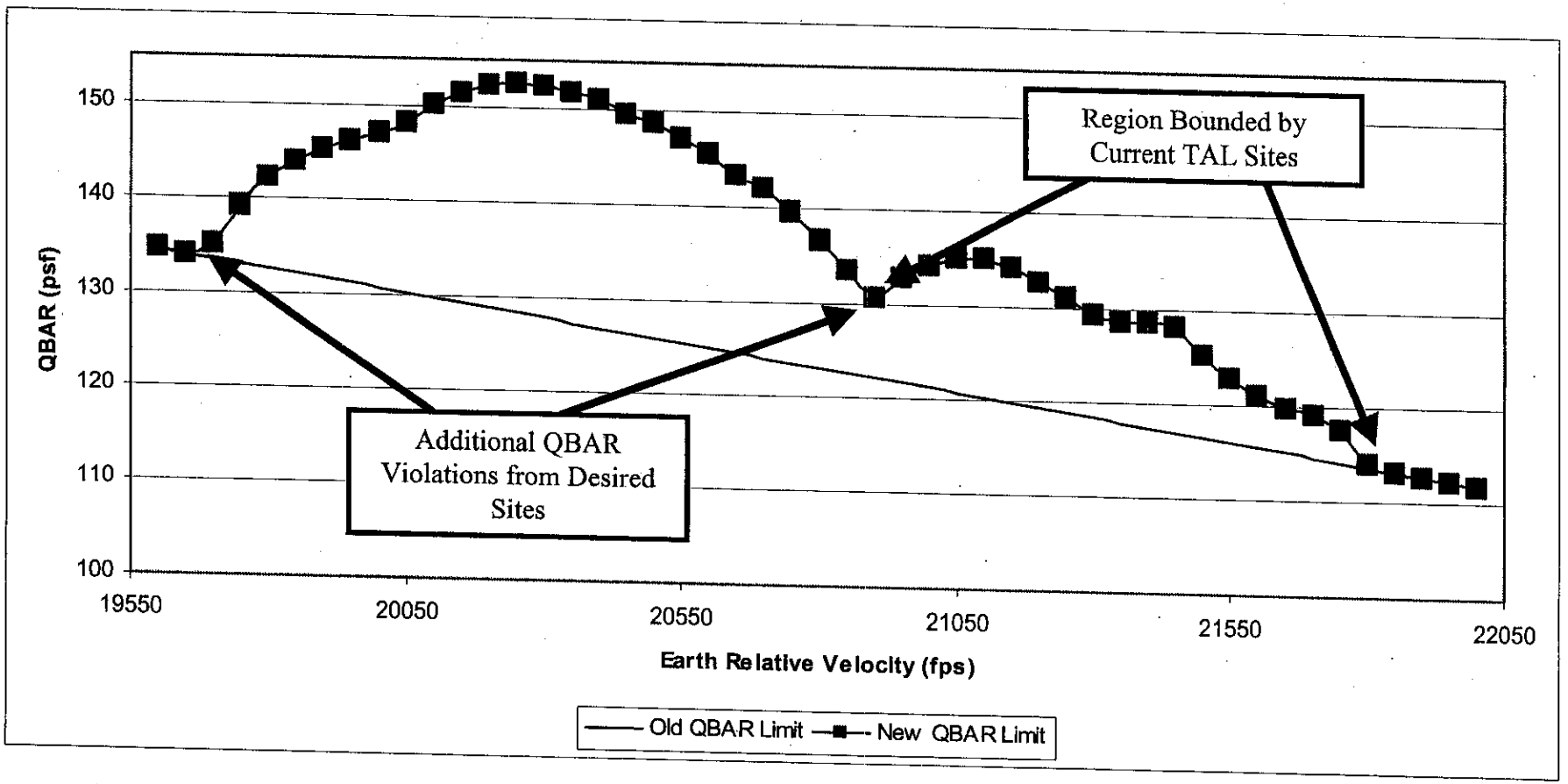
- High Inc 348k MRN has highest QBAR delta from SODB Limit
  - Region alone does not cover all ZZA High Inc region
  - ZZA QBAR peak shifts along VE to region outside MRN peak
- High Inc 348k ZZA line must be included to cover all current TAL sites at 348k/0.8

Required 348k QBAR Limit Changes



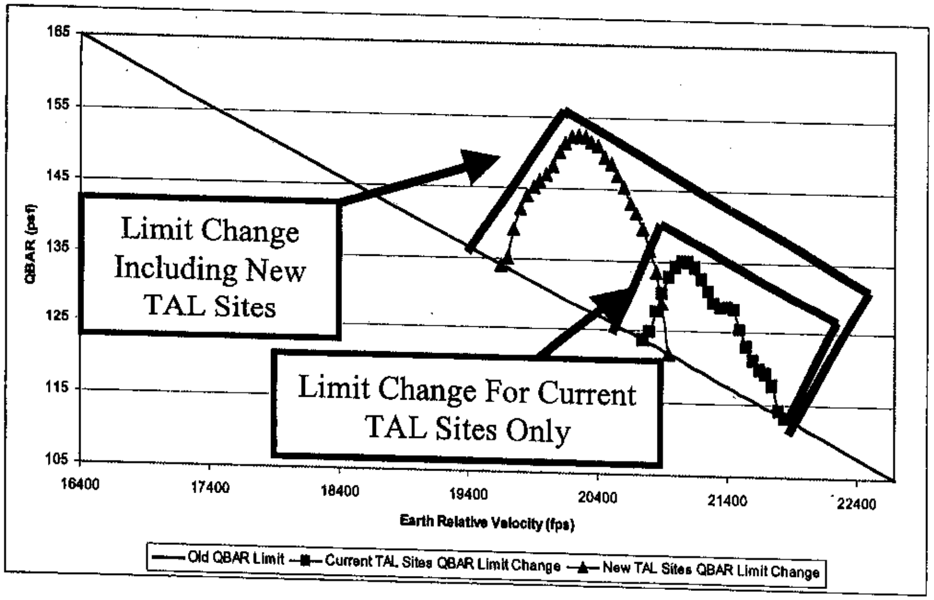
- New limit includes max of MRN and ZZA data at each VE point
- VE scale includes entire SODB QBAR region of interest

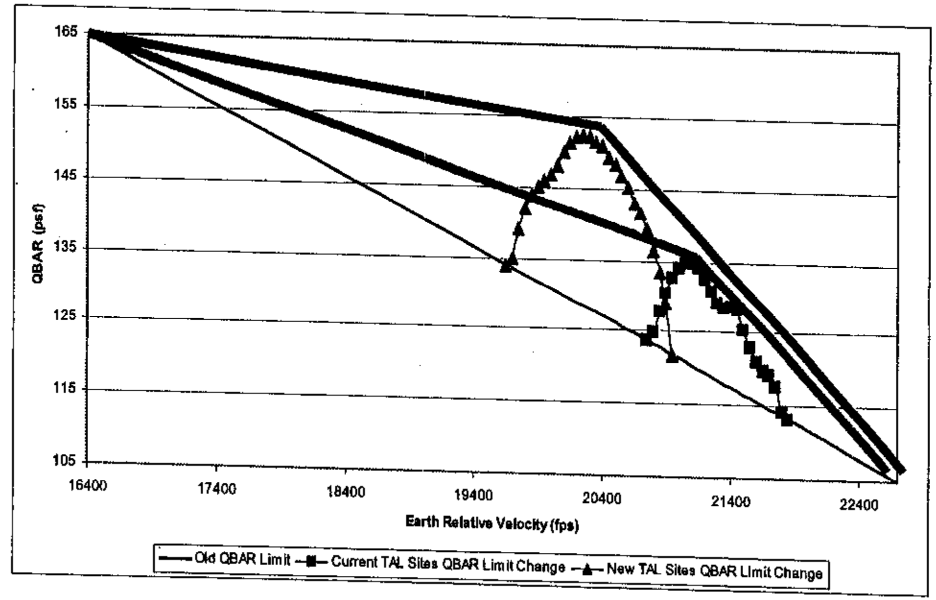
Inclusion of Desired New TAL Sites

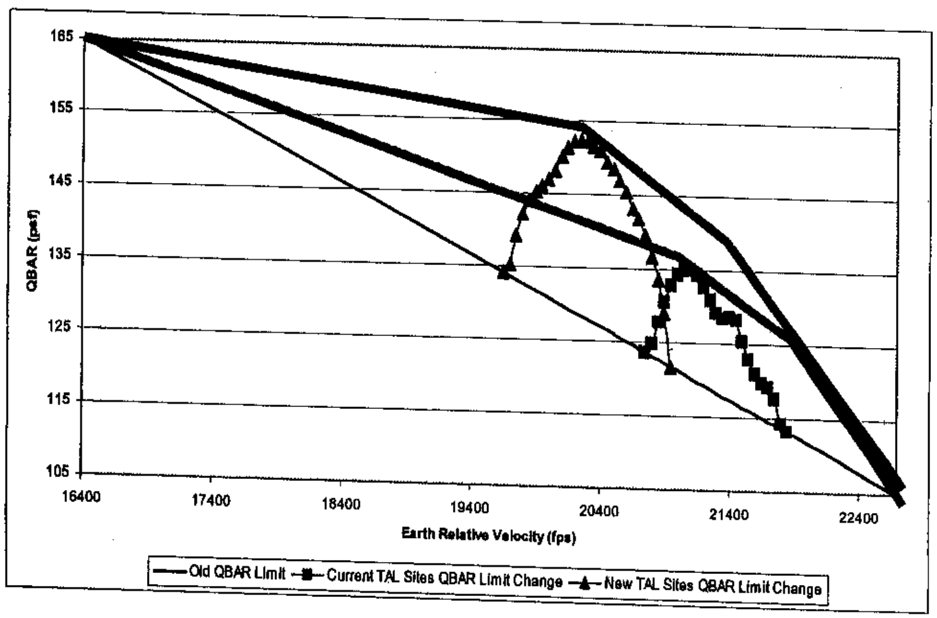


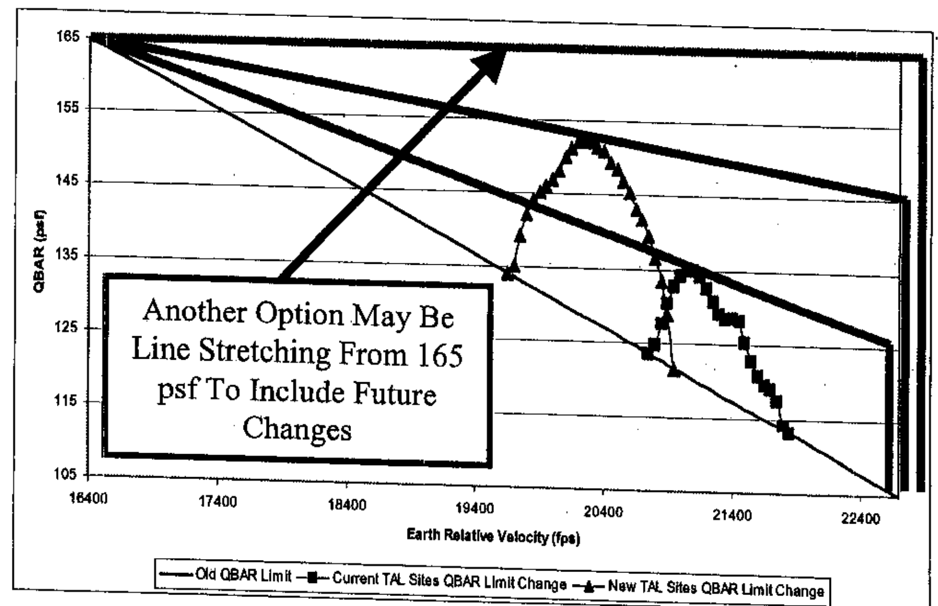
- Abort PE may include upgrading two ELS sites to TAL sites
  - Las Palmas (GDV) & Amilcar, Cabral (AML)
  - Improve early TAL capability along with 5th segment booster
- Inclusion of sites now prevents possible repeat of process later
  - Changes to QBAR limit for current TAL sites may not include new, large region

Possible QBAR Limit Changes

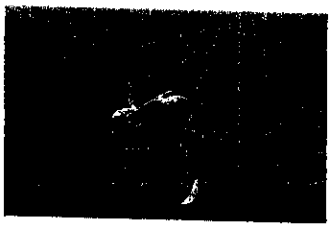








DM42/M. Schottel



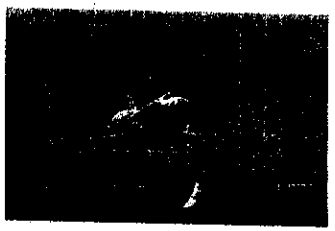
BOEING

GRTLS Expansion: Groundrules and Constraints

Kevin Blankinship

12/17/2002

Boeing NASA Systems



Analysis Approach

BOEING

- **Select flight conditions for stability analysis based on trajectory correlations.**

- **Verify that the stability margin requirements are met at the:**

  - Envelope boundaries
  - Mass properties extremes
  - Hot and cold US1962 atmospheres + November Gram atmosphere
  - Driving aerodynamic variations.

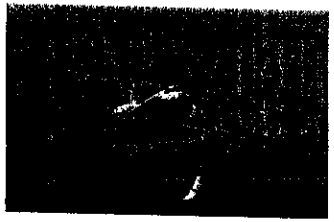
- **Follow-up with trajectory analysis:**

  - Modify SDAP to include GRAM atmosphere.

Assumptions

BOEING

- **Analysis will be based on the OI-29 build.**
- **It is assumed that the stability margin requirements of 6dB gain margin/30 degrees phase margin will be met throughout the new boundaries:**
  - Schedule and budget are based on this assumption.
  - Violation of this assumption may require flight software modifications to meet these boundaries, but this again assumes that the stability margins can be achieved with software modifications.



Selection of Points for Analysis

BOEING

- **Dynamic Pressure Envelope:**
  - Selected points*:

VREL, FT/SEC	6100.00	5977.80	5644.40	5588.90	6400.00	3800.00	4500.00	5700.00	6400.00	7326.70	7531.40	7586.30
QBAR, PSF	90	40	10	3	575	440	471	900	175	48.40	10	2

  - Flight conditions selected for analysis will use correlations of dynamic pressure versus angle of attack.
- **Angle of Attack Envelope:**
  - Because the study calls for reformulation of the angle-of-attack envelope in terms of VREL, all boundary points have to be evaluated.
  - Selected points comprise the entire existing lower alpha/mach boundary and the proposed upper alpha/mach boundary.
  - Flight conditions selected for analysis will use correlations of angle of attach versus dynamic pressure, and mach versus VREL.

*Points are selected based on the envelope boundary, critical stability points of interest, and flight control law mode transition boundaries.

TAL QBAR ENVELOPE EXPANSION: PRELIMINARY STABILITY ASSESSMENT PLAN

Milt Reed – 16 December 2002

DATA NEEDS

- Monte Carlo trajectory overview plots (to understand scenario).
  - IC data for running selected SDAP trajectories.
- Monte Carlo tabulated data for specified values of Mach or Vrel for selection of correlated Qbar-Alpha (need Mach or Vrel, Qbar, Alpha, Gamma or Hdot, and Phi for Strim setup. Elevon and Bodyflap are useful reference quantities. Speedbrake = 0 since Mach > 10.
- Monte Carlo plots of Qbar-Alpha ellipses.
- Applicable mass properties.
  - One or two vehicle weights?
  - Forward and aft cg?
  - Moments of inertia.
- Applicable atmospheres and lift-over-drag (LOD) uncertainties.
  - Strim has only 1962 Standard Atmosphere available.

TAL QBAR ENVELOPE EXPANSION - STABILITY

FLIGHT CASES

- 10 – 12 cases (Qbar vs. Vrel points) on and within specified violation regions ("current" and "new").
- 10-15 additional cases on and within the new Qbar limit envelope.
  - Specific envelope to be used is TBD.

FLIGHT CASE DISPERSIONS

- Forward and aft cg.
- One or two vehicle weights.
- One or two atmospheres.
- One orbiter vehicle (probably OV-105).
- Y-cg off-set and bent airframe for static trim assessment.
- Nominal aero and two short-period pitch aero uncertainty sets (Pvars) for pitch axis stability assessment.
- Nominal aero and four or five roll-yaw aero uncertainty sets (Lvars) with appropriate pitching moment coefficient uncertainty for static trim and roll-yaw axis stability assessment.

TAL QBAR ENVELOPE EXPANSION - STABILITY

BASELINE AEROJET DAP (TAL does not use the Wraparound DAP).

STABILITY ASSESSMENT LOOPS

- Pitch axis: elevon loop (all cases have Qbar > 40 so pitch jets are not used).
- Roll-Yaw axis: aileron and yaw RCS loops (roll jets and rudder are not used in the region of interest).

EXTENSION TO NEOM, AOA

- Additional Monte Carlo data and flight case selection required.
  - Different Qbar-Alpha correlations from TAL.
- Wraparound DAP stability assessment required.
  - Affects pitch axis as well as lateral-directional.

Michele Lewis

From: Wang, Kuo [Kuo.Wang@boeing.com]
Sent: Friday, December 13, 2002 5:44 PM
To: DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA)
Cc: Chao, Dennis C; Alexander, Ed C
Subject: Body flap heating comparsion


sts1_bf_def.pdf

sts2_bf_def.pdf

sts2_bf_temp.pdf

STS-107EOM_BFLAP_Comp.pd

QRMAX-BFDEFL22.pdf

compWTR-vs-DEF22.pdf

compHW-vs-defl22.pdf

Hi Steve,

Following is an explaination of contents of each pdf file :

1) sts1_bf_def.pdf contains the STS-1 body flap deflection plot.
2) sts2_bf_def.pdf contains the STS-2 body flap deflection plot.
3) sts2_bf_temp.pdf contains plots of 5 body flap body points temperature plot.
4) STS-107EOM_BFLAP_Comp.pdf contains plots of heating rate comparsion of all body flap body points of nominal STS-107 EOM trajectory vs trajectory with 22 degree body flap deflection.
5) QRMAX-BFDEFL22.pdf is a print of maximum heating rate, maximum wall temperature and total heat load of all 41 body flap body points of the STS-107 EOM trajectory with 22 deg. body flap deflection.
6) compWTR-vs-DEF22.pdf is a print of comparsion of maximum heating rate and total herat load of STS-107 EOM with 22 deg. body flap defaction with a data book western test range case which has body flap deflaction around 18 degree.
compHW-vs-def22.pdf is a print of comparsion of maximum heating rate and total heat load of STS-107 EOM with 22 deg. body flap deflaction with a data book heavy weight early transition EOM case.

If you have any question please call me at (281) 853-1798 (O) or (H).

<<sts1_bf_def.pdf>> <<sts2_bf_def.pdf>> <<sts2_bf_temp.pdf>>
<<STS-107EOM_BFLAP_Comp.pdf>> <<QRMAX-BFDEFL22.pdf>>
<<compWTR-vs-DEF22.pdf>> <<compHW-vs-defl22.pdf>>

K. C. Wang
Aerothermal Analysis
Phone: (281) 853-1798
Fax : (281) 853-1525
e-mail: kuo.wang@boeing.com

From: LEVY, VINCENT M. (JSC-EG) (NASA)
Sent: Monday, February 24, 2003 4:48 PM
To: POPE, HERMAN A. (ALEX) (JSC-EG) (NASA)
Cc: GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA); ONDLER, R. M. (MATT) (JSC-EG) (NASA); KANIPE, DAVID B. (DAVE) (JSC-EG) (NASA); LEVY, VINCENT M. (JSC-EG) (NASA); MILLER, GLENN J. (JSC-EA) (NASA)
Subject: EG/Levy:STS-107 Ascent Debris collected e-mails


FW: STS-107 Post-Launch Film R..


STS-107 Debris Impact Analysis...


RE: STS-107 Debris Analysis T...


FW: STS-107 Debris Briefing fo...


Wheel well image for Disler


STS-107 vestigation - Ascent

Here are the debris related e-mails from Jan 17 to Feb 1, 2003.

Vincent M. Levy
EG/Aeroscience & Flight Mechanics
Shuttle Division Chief Engineer
281-483-0874 (w)

281-483-1245 (fax)

Michele Lewis

From: LEVY, VINCENT M. (JSC-EG) (NASA)
Sent: Tuesday, February 25, 2003 1:50 PM
To: POPE, HERMAN A. (ALEX) (JSC-EG) (NASA)
Cc: ONDLER, R. M. (MATT) (JSC-EG) (NASA)
Subject: EG/Levy: STS-107 Debris Collected e-mails

From: "LEVY, VINCENT M. (JSC-EG) (NASA)" <vincent.m.levy@nasa.gov>
Date: Fri, 31 Jan 2003 13:23:09 -0600
To: "SHACK, PAUL E. (JSC-EA42) (NASA)" <paul.e.shack@nasa.gov>
Cc: "ROE, RALPH R. (JSC-MV) (NASA)" <ralph.r.roe@nasa.gov>, "LAW, HOWARD G.
(JSC-EG) (NASA)" <howard.g.law@nasa.gov>, "'Harder, James R'" <james.r.harder@boeing.com>
Subject: Ames Engineering Study

Paul- Spoked to Jim Harder(Entry Flight Control SSM) and Howard Law.

The Ames engineering matrix was ran as agreed with the Orbiter Project. Emphasis was placed on understanding handling qualities with the new persistence tire model. One of the areas of concern identified was the lost of a second tire based on the new load persistence model. The team evaluated mitigation techniques to avoid lost of the second tire and subsequent damage to the orbiter structure and loss of crew/vehicle. These mitigation techniques were part of the approved matrix discussed with the Orbiter Project. On a special request(which is not unusual) from the Crew - the team did evaluate one case consisting of full lateral RHC with the Nose in the air to evaluate a procedure for second tire lost . This had been an open item from a prior training session which they now have agreed doesn't need to be pursued any more.

If you have any more details to specifics concerns I will discuss further with the flight control guys when they get back on Monday.

Vincent M. Levy
EG/Aeroscience & Flight Mechanics
Shuttle Division Chief Engineer
281-483-0874 (w)

281-483-1245 (fax)

------ End of Forwarded Message

From: DISLER, JONATHAN M. (JON) (JSC-SX) (LM)
Sent: Thursday, January 23, 2003 5:49 PM
To: GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA)
Cc: CLOUDT, CHRIS R. (JSC-SX) (HEI)
Subject: Link to Full Resolution Images of ET208 and E212

Ray,

You can retrieve the high resolution TIF images (640x480) for the STS-107 views of the debris strike at the following link:

http://sn-isag.jsc.nasa.gov/shuttleweb/mission_support/sts-107/107frames.shtml

There are a total of 14 frames on the ET208 sequence. Frame # 30011 is the impact frame on the ET208 view.

There are 3 frames on the E212 sequence. Frame 3 is the impact frame on the E212 sequence.

Call or e-mail Chris or me in the morning if you have any questions. Thanks a lot Ray. This will be very interesting...

Jon Disler

&

Chris Cloudt
Image Science & Analysis Group
Human Exploration Science Office/ SX3
Hernandez Engineering Inc./JSC
ccloudt@ems.jsc.nasa.gov
(281) 483-5336

From: CLOUDT, CHRIS R. (JSC-SX) (HEI)
Sent: Monday, January 27, 2003 7:32 AM
To: GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA)
Subject: RE: Link to Full Resolution Images of ET208 and E212

Rey,

Thanks for the fantastic CAD model. It overlays virtually perfectly on the ET208 camera view. Along with the track that was also overlayed, we can get a real feel for where the debris hit occurred. Here is a link to the page where the product is located:

http://sn-isag.jsc.nasa.gov/shuttleweb/mission_support/sts-107/208_debristrack_overlay2.jpg

Thanks again for the great work-

Chris

Chris Cloudt
Image Science & Analysis Group
Human Exploration Science Office/ SX3
Hernandez Engineering Inc./JSC
ccloudt@ems.jsc.nasa.gov
(281) 483-5336

-----Original Message-----
From: GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA)
Sent: Friday, January 24, 2003 3:10 PM
To: DISLER, JONATHAN M. (JON) (JSC-SX) (LM)
Cc: CLOUDT, CHRIS R. (JSC-SX) (HEI)
Subject: RE: Link to Full Resolution Images of ET208 and E212

Jon and Chris,

I made a quick attempt to align my model with one of the frames from the ET208 camera. It isn't exactly 640x480 (actually 477).

Let me know if it works for you.

<< File: 208_30011_cad.tif >>
Ray

Reynaldo J. Gomez — Aeroscience and Flight Mechanics Div.
Mail Code EG3 — phone: 281-483-6108
NASA Johnson Space Center — fax: 281-244-5256
Houston, TX 77058 — e-mail: reynaldo.j.gomez@nasa.gov

-----Original Message-----
From: DISLER, JONATHAN M. (JON) (JSC-SX) (LM)
Sent: Thursday, January 23, 2003 5:49 PM

From: WALLACE, RODNEY O. (ROD) (JSC-MS2) (NASA)
Sent: Tuesday, January 21, 2003 8:28 AM
To: 'White, Bob'; GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA)
Cc: AUSTIN, LAMBERT D. (JSC-MS) (NASA)
Subject: FW: Preliminary - STS-107 In-flight Debris Impact

Keep me informed of our analysis status.

-----Original Message-----
From: AUSTIN, LAMBERT D. (JSC-MS) (NASA)
Sent: Friday, January 17, 2003 3:43 PM
To: WALLACE, RODNEY O. (ROD) (JSC-MS2) (NASA)
Subject: FW: Preliminary - STS-107 In-flight Debris Impact

Need someone to work this---------

-----Original Message-----
From: Page-1, Robert [mailto:Robert.W.Page@nasa.gov]
Sent: Friday, January 17, 2003 3:15 PM
To: HALE, N. W., JR (WAYNE) (JSC-MA) (NASA); ROE, RALPH R. (JSC-MV) (NASA)
Cc: Oliu-1, Armando; Segert-1 Randall; Tom Rieckhoff; DISLER, JONATHAN M. (JON) (JSC-SX) (LM); Bauder, Stephen P; AUSTIN, LAMBERT D. (JSC-MS) (NASA)
Subject: Preliminary - STS-107 In-flight Debris Impact

Preliminary
01-17-2003, 16:00 EDT

http://sn-isag.jsc.nasa.gov/shuttleweb/mission_support/sts-107/launch_video/107launchvideo.shtml

http://photo4.msfc.nasa.gov/STS/sts107/#L2

Above are links to views from the video. These are low resolution views and the debris and strike may be difficult to discern.

A clip produced from film camera E212 is currently being produced by KSC and will be transferred to JSC for display on the above link.

The debris item seems to originate from the area of the -Y ET Bipod Attach Point about 80-84 seconds into flight. This debris subsequently impacts the orbiter left wing, in the area of transition from Chine to Main Wing, creating a shower of smaller particles. Impact appears to be totally on the lower surface, since no particles are seen to traverse over the upper surface of the wing. However, more analysis is required to determine details on impact location. More film analysis will occur over the weekend as films become available.

A transport analysis has been requested from Boeing Integration to determine trajectories, velocities, angles and energies associated with this debris impact.

More information to follow.

Bob Page
NASA/MK-SIO
(321)867-8516

STS-107 Debris Analysis Team MeetingFrom: Madera, Pamela L
[pam.l.madera@usahq.unitedspacealliance.com]
Sent: Wednesday, January 22, 2003 11:22 AM
To: CURRY, DONALD M. (JSC-ES3) (NASA); ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA); LEVY, VINCENT M. (JSC-EG) (NASA); KOWAL, T. J. (JOHN) (JSC-ES3) (NASA); DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA); Nagle, Scott M; Carlos Ortiz (E-mail); GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA); DISLER, JONATHAN M. (JON) (JSC-SX) (LM); Jacobs, William A
Cc: 'Scott Christensen V (E-mail)'; 'Norman Ignacio (Nacho) (E-mail)'; CHAO, DENNIS; Stoner-1, Michael D; 'Carlos Ortiz (E-mail)'; 'Michael J Dunham (E-mail)'; Sebesta, Stephen P; CORONADO, DIANA; ''Craig Madden' (E-mail)'; Bell, Dan R.; Gordon, Michael P.; 'Paul A Parker (E-mail)'; ISHMAEL, MOHAMED I. (GEORGE) (JSC-NC) (SAIC); ALEXANDER, ED
Subject: STS-107 Debris Analysis Team Meeting

Rodney Rocha has conference room 221 in JSC Building 13 available for today's 1:00 PM telecon. Located on second floor. The dial in number is the same as below. I propose the following agenda:

Review of transport analysis (Carlos Ortiz - charts attached)
Discussion of appropriate Particle Size (Ortiz, Disler, all)
Review of Flight Design Plans for Assessing Options (Bill Jacobs)
Status of Impact Damage Assessment (P. Parker)
Status of Thermal Analysis (Norm Ignacio/Dennis Chao)
Approach for stress assessment (Dunham)
Discussion on Need/Rationale for Mandatory Viewing of damage site (All)

<<STS-107 Preliminary Debris Assessment - rev2.ppt>>

Pam Madera
Vehicle and Systems Analysis Subsystem Area Manager
Phone: 281-282-4453

-----Original Message-----
From: Madera, Pamela L
Sent: Monday, January 20, 2003 5:47 PM
To: CURRY, DONALD M; ROCHA, ALAN RODNEY; LEVY, VINCENT M; KOWAL, T JOHN; DERRY, STEPHEN M
Cc: 'Scott Christensen V (E-mail)'; 'Norman Ignacio (Nacho) (E-mail)'; CHAO, DENNIS; Stoner-1, Michael D; 'Carlos Ortiz (E-mail)'; 'Michael J Dunham (E-mail)'; Sebesta, Stephen P; CORONADO, DIANA; ''Craig Madden' (E-mail)'; Bell, Dan R.; Gordon, Michael P.; Paul A Parker (E-mail)

Subject: STS-107 Debris Analysis Team Plans

The Boeing/USA team would like to meet with you Tuesday at 2:00 on meet-me-line number to discuss analysis plans for assessing the STS-107 Debris Impact.

Pam Madera
Vehicle and Systems Analysis Subsystem Area Manager
Phone: 281-282-4453

STS-107 Debris Impact Analysis status.txt

From: GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA)
Sent: Wednesday, January 22, 2003 11:09 AM
To: WALLACE, RODNEY O. (ROD) (JSC-MS2) (NASA)
Cc: LEVY, VINCENT M. (JSC-EG) (NASA); LABBE, STEVEN G. (STEVE) (JSC-EG3) (NASA); KANIPE, DAVID B. (DAVE) (JSC-EG) (NASA); RICHART, JENE A. (JSC-MS2) (NASA); 'Ortiz, Carlos'
Subject: STS-107 Debris Impact Analysis status

Rod,

We held an Aerodynamics Panel meeting yesterday afternoon to review Boeing's debris analysis results of the STS-107 debris shown in several of the launch films and videos.

I have attached a PowerPoint file containing two slides showing Boeing's best estimate impact area, velocity and angle of incidence for the debris seen in the launch films. This information, with some additional annotations, has been passed to the Orbiter TPS organization so that they can predict probable damage from this debris. The highest angles of incidence are near the leading edge and Carlos Ortiz is adding a line to indicate where the wing transitions from RCC to tiles to clarify which angles should be used with which materials.

The debris source appears to be similar to that seen in STS-112 however the debris release time and conditions are quite different:

STS-107 82 seconds (altitude)	Mach 2.6	Alpha 2.3 deg. 70,500 feet
STS-112 33 seconds	Mach 0.75	Alpha -3.3 deg. 12,000 feet

The change in angle of attack is the primary reason that STS-112 had a debris impact on the IEA/Attach Ring vs. the STS-107 impact on the Orbiter wing.

I will continue to support the Loads/GN&C/Thermal Panel meetings on this issue and give you updates on our status.

Ray

Reynaldo J. Gomez
Mail Code EG3
NASA Johnson Space Center
Houston, TX 77058

Aeroscience and Flight Mechanics Div.
phone: 281-483-6108
fax: 281-244-5256
e-mail: reynaldo.j.gomez@nasa.gov

Michele Lewis

From: GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA)
Sent: Wednesday, January 22, 2003 9:49 AM
To: ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)
Cc: LABBE, STEVEN G. (STEVE) (JSC-EG3) (NASA); LEVY, VINCENT M. (JSC-EG) (NASA)
Subject: Requesting ET wireframe CAD model from L-M Michoud

Rodney,

I would like to get a copy of an External Tank wireframe CAD model from Lockheed Martin Space Systems - Michoud. I plan to use this model as a reference for our current Space Shuttle Launch Vehicle geometry and to use it in support of the current STS-107 debris issue.

I have spoken to Ashok Prabhakar at Michoud regarding this model and he indicated that I should contact you so that you can give him the go ahead to release the model to me. If you need any additional information give me a call or send e-mail.

Thanks,

Ray

Reynaldo J. Gomez
Mail Code EG3
NASA Johnson Space Center
uston, TX 77058

Aeroscience and Flight Mechanics Div.
phone: 281-483-6108
fax: 281-244-5256
e-mail: reynaldo.j.gomez@nasa.gov

Michele Lewis

From: GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA)
Sent: Thursday, January 30, 2003 9:36 AM
To: 'Bute, Norma J'
Subject: RE: ET geometry request and STS-107 debris

Norma,

I was able to download the file and read it into our CAD programs. I appreciate Dewey's and your help in getting this done.

I have one question about the geometry file. Is this geometry for the inner mold line, without any TPS?

Thanks,

Ray

Reynaldo J. Gomez — Aeroscience and Flight Mechanics Div.
Mail Code EG3 — phone: 281-483-6108
NASA Johnson Space Center — fax: 281-244-5256
Houston, TX 77058 — e-mail: reynaldo.j.gomez@nasa.gov

-----Original Message-----
From: Bute, Norma J [mailto:Norma.J.Bute@maf.nasa.gov]
Sent: Thursday, January 30, 2003 8:25 AM
To: GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA)
Subject: RE: ET geometry request and STS-107 debris

Ray,

Dewey Crosby set up access for you to the website where we have the ET wire frame model available. Please let me know if you were able to download it.

Norma J Bute

Aeronautical Engineer Sr
Loads and Dynamics
Lockheed Martin Space Systems Company
Michoud Operations
13800 Old Gentilly Road, MS 4170
New Orleans, LA 70129
Norma.J.Bute@maf.nasa.gov
(504)257-3409
(504)257-4458 FAX

-----Original Message-----
From: GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA)
[mailto:reynaldo.j.gomez@nasa.gov]

Sent: Wednesday, January 29, 2003 1:48 PM
To: ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)
Subject: ET geometry request and STS-107 debris

Rodney,

I would appreciate it if you could give Ashok Prabhakar the go ahead to release an External Tank CAD model to me. He has indicated that the file is ready to send but he is awaiting approval from you before he can release it to me. I would like to get a head start on the post STS-107 analysis that will probably require us to take another look at the External Tank protuberance airloads.

Based on the work done to support this STS-107 debris impact assessment, the Crater code sounds like it could use some updating and some additional validation. Don Curry brought up the hypervelocity impact codes that SN uses for on-orbit debris and Eric Christensen has indicated that their codes are applicable to tile impacts at these velocities. These codes along with some additional testing could probably be used to updated the Crater code so that it produces more realistic results. If there is any way that I can help support these improvements let me know.

Ray

Reynaldo J. Gomez Aeroscience and Flight Mechanics Div.
Mail Code EG3 phone: 281-483-6108
NASA Johnson Space Center fax: 281-244-5256
Houston, TX 77058 e-mail: reynaldo.j.gomez@nasa.gov

Michele Lewis

From: GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA)
Sent: Wednesday, January 29, 2003 2:48 PM
To: ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)
Subject: ET geometry request and STS-107 debris

Rodney,

I would appreciate it if you could give Ashok Prabhakar the go ahead to release an External Tank CAD model to me. He has indicated that the file is ready to send but he is awaiting approval from you before he can release it to me. I would like to get a head start on the post STS-107 analysis that will probably require us to take another look at the External Tank protuberance airloads.

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Ray

Reynaldo J. Gomez
Mail Code EG3
NASA Johnson Space Center
Houston, TX 77058

Aeroscience and Flight Mechanics Div.
phone: 281-483-6108
fax: 281-244-5256
e-mail: reynaldo.j.gomez@nasa.gov

Michele Lewis

From: GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA)
Sent: Friday, January 24, 2003 5:23 PM
To: LABBE, STEVEN G. (STEVE) (JSC-EG3) (NASA); LEVY, VINCENT M. (JSC-EG) (NASA); 'Ortiz, Carlos'
Cc: STUART, PHILLIP C. (PHIL) (JSC-EG) (NASA)
Subject: FW: Overlay ET208

I sent an image to Jon Disler and he sent me back the composited image.

Ray

Reynaldo J. Gomez — Aeroscience and Flight Mechanics Div.
Mail Code EG3 — phone: 281-483-6108
NASA Johnson Space Center — fax: 281-244-5256
Houston, TX 77058 — e-mail: reynaldo.j.gomez@nasa.gov

-----Original Message-----
From: DISLER, JONATHAN M. (JON) (JSC-SX) (LM)
Sent: Friday, January 24, 2003 4:17 PM
To: GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA)
Subject: FW: Overlay ET208

Ray,

Take a look. I think this will be a big hit. Thanks again.. Jon

-----Original Message-----
From: CLOUDT, CHRIS R. (JSC-SX) (HEI)
Sent: Friday, January 24, 2003 3:45 PM
To: DISLER, JONATHAN M. (JON) (JSC-SX) (LM)
Subject: Overlay ET208

208_debristrac
k_overlay.jpg

Chris Cloudt
Image Science & Analysis Group
Human Exploration Science Office/ SX3
Hernandez Engineering Inc./JSC
ccloudt@ems.jsc.nasa.gov
(281) 483-5336

Michele Lewis

From: GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA)
Sent: Wednesday, January 22, 2003 5:05 PM
To: WALLACE, RODNEY O. (ROD) (JSC-MS2) (NASA)
Cc: LEVY, VINCENT M. (JSC-EG) (NASA); LABBE, STEVEN G. (STEVE) (JSC-EG3) (NASA)
Subject: Follow up on Loads/GN&C/Thermal Panel meeting

Rod,

A couple of things came up after you left the meeting:

1) STS-107 debris is larger than any debris database in the current CRATER or Boeing impact codes.
2) Boeing TPS is prepared to perform analysis on missing tile configurations and will work with Boeing Stress to come up with a reasonable test of runs.
3) Boeing Stress is not planning on performing any additional burn through assessment work.
4) It sounds like the STS-87 entry weight and inclination are fairly close to STS-107 (weight within 1000 lbs) and the missing tile work on STS-87 should be applicable.

I can see that we will have some follow on work after the vehicle lands:

1) Reverify the CRATER code and update it to include the 22 lb tiles
2) Revisit the protuberance air loads on the bipod ramp
3) I would like to see some improvements to our debris trajectory prediction capability.

ay

Reynaldo J. Gomez
Mail Code EG3
NASA Johnson Space Center
Houston, TX 77058

Aeroscience and Flight Mechanics Div.
phone: 281-483-6108
fax: 281-244-5256
e-mail: reynaldo.j.gomez@nasa.gov

Michele Lewis

From: ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)
Sent: Tuesday, January 21, 2003 5:41 PM
To: SHACK, PAUL E. (JSC-EA42) (NASA); HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA); MILLER, GLENN J. (JSC-EA) (NASA)
Cc: SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA); ROGERS, JOSEPH E. (JOE) (JSC-ES2) (NASA); GALBREATH, GREGORY F. (GREG) (JSC-ES2) (NASA)
Subject: STS-107 Wing Debris Impact, Request for Outside Photo-Imaging Help

Paul and Dave,
The meeting participants (Boeing, USA, NASA ES2 and ES3, KSC) all agreed we will always have big uncertainties in any transport/trajectory analyses and applicability/extrapolation of the old Arc-Jet test data until we get definitive, better, clearer photos of the wing and body underside. Without better images it will be very difficult to even bound the problem and initialize thermal, trajectory, and structural analyses. Their answers may have a wide spread ranging from acceptable to not-acceptable to horrible, and no way to reduce uncertainty. Thus, giving MOD options for entry will be very difficult.*

Can we petition (beg) for outside agency assistance? We are asking for Frank Benz with Ralph Roe or Ron Dittemore to ask for such. Some of the old timers here remember we got such help in the early 1980's when we had missing tile concerns.

*Despite some nay-sayers, there are some options for the team to talk about: On-orbit thermal conditioning for the major structure (but is in contradiction with tire pressure temp. cold limits), limiting high cross-range de-orbit entries, constraining right or left had turns during the Heading Alignment Circle (only if there is struc. damage to the RCC panels to the extent it affects flight control.

Rodney Rocha
Structural Engineering Division (ES-SED)
ES Div. Chief Engineer (Space Shuttle DCE)
- **Chair, Space Shuttle Loads & Dynamics Panel**

Mail Code ES2 Phone 281-483-8889

Michele Lewis

From: ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)
Sent: Sunday, January 26, 2003 8:45 PM
To: SHACK, PAUL E. (JSC-EA42) (NASA); MCCORMACK, DONALD L. (DON) (JSC-MV6) (NASA); OUELLETTE, FRED A. (JSC-MV6) (NASA)
Cc: ROGERS, JOSEPH E. (JOE) (JSC-ES2) (NASA); GALBREATH, GREGORY F. (GREG) (JSC-ES2) (NASA); JACOBS, JEREMY B. (JSC-ES4) (NASA); SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA); KRAMER, JULIE A. (JSC-EA4) (NASA); CURRY, DONALD M. (JSC-ES3) (NASA); KOWAL, T. J. (JOHN) (JSC-ES3) (NASA); RICKMAN, STEVEN L. (JSC-ES3) (NASA); SCHOMBURG, CALVIN (JSC-EA) (NASA); CAMPBELL, CARLISLE C., JR (JSC-ES2) (NASA)
Subject: STS-107 Wing Debris Impact on Ascent: Final analysis case completed

As you recall from Friday's briefing to the MER, there remained open work to assess analytically predicted impact damage to the wing underside in the region of the main landing gear door. This area was considered a low probability hit area by the image analysis teams, but they admitted a debris strike here could not be ruled out.

As with the other analyses performed and reported on Friday, this assessment by the Boeing multi-technical discipline engineering teams also employed the system integration's dispersed trajectories followed by serial results from the *Crater* damage prediction tool, thermal analysis, and stress analysis. It was reviewed and accepted by the ES-DCE (R. Rocha) by Sunday morning, Jan. 26. The case is defined by a large area gouge about 7 inch wide and about 30 inch long with sloped sides like a crater, and reaching down to the densified layer of the TPS.

SUMMARY: Though this case predicted some higher temperatures at the outer layer of the honeycomb aluminum face sheet and subsequent debonding of the sheet, there is no predicted burn-through of the door, no breeching of the thermal and gas seals, nor is there door structural deformation or thermal warpage to open the seal to hot plasma intrusion. Though degradation of the TPS and door structure is likely (if the impact occurred here), there is no safety of flight (entry, descent, landing) issue.

Note to Don M. and Fred O.: On Friday I believe the MER was thoroughly briefed and it was clear that open work remained (viz., the case summarized above), the message of open work was not clearly given, in my opinion, to Linda Ham at the MMT. I believe we left her the impression that engineering assessments and cases were all finished and we could state with finality no safety of flight issues or questions remaining. This very serious case could not be ruled out and it was a very good thing we carried it through to a finish.

Rodney Rocha (ES2) x38889

- **Division Shuttle Chief Engineer (DCE), ES-Structural Engineering Division**
- **Chair, Space Shuttle Loads & Dynamics Panel**

Michele Lewis

From: ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)
Sent: Wednesday, January 22, 2003 6:15 PM
To: SHACK, PAUL E. (JSC-EA42) (NASA)
Subject: RE: STS-107 Wing Debris Impact, Request for Outside Photo-Imaging Help

Paul,
Can you tell us more on Roe's negative answer? Is he and the SSP waiting on our analysis results first (Friday to the MMT) or what? What is Frank's position?

Rodney Rocha
Structural Engineering Division (ES-SED)
- **ES Div. Chief Engineer (Space Shuttle DCE)**
- **Chair, Space Shuttle Loads & Dynamics Panel**

Mail Code ES2 Phone 281-483-8889

Michele Lewis

From: MCCORMACK, DONALD L. (DON) (JSC-MV6) (NASA)
Sent: Monday, January 27, 2003 6:32 AM
To: ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)
Cc: OUELLETTE, FRED A. (JSC-MV6) (NASA); SHACK, PAUL E. (JSC-EA42) (NASA)
Subject: RE: STS-107 Wing Debris Impact on Ascent: Final analysis case completed

Rodney,
I thought that I mentioned to the MMT that we had run all but one case, although it may have not been clearly stated. I'll make sure that she understands that this final case has been completed.
Don

-----Original Message-----
From: ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)
Sent: Sunday, January 26, 2003 7:45 PM
To: SHACK, PAUL E. (JSC-EA42) (NASA); MCCORMACK, DONALD L. (DON) (JSC-MV6) (NASA); OUELLETTE, FRED A. (JSC-MV6) (NASA)
Cc: ROGERS, JOSEPH E. (JOE) (JSC-ES2) (NASA); GALBREATH, GREGORY F. (GREG) (JSC-ES2) (NASA); JACOBS, JEREMY B. (JSC-ES4) (NASA); SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA); KRAMER, JULIE A. (JSC-EA4) (NASA); CURRY, DONALD M. (JSC-ES3) (NASA); KOWAL, T. J. (JOHN) (JSC-ES3) (NASA); RICKMAN, STEVEN L. (JSC-ES3) (NASA); SCHOMBURG, CALVIN (JSC-EA) (NASA); CAMPBELL, CARLISLE C., JR (JSC-ES2) (NASA)
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Rodney Rocha (ES2) x38889
- **Division Shuttle Chief Engineer (DCE), ES-Structural Engineering Division**
- **Chair, Space Shuttle Loads & Dynamics Panel**

Michele Lewis

From: ORTIZ-LONGO, CARLOS R., PHD (JSC-EA4) (NASA)
Sent: Monday, January 27, 2003 12:48 PM
To: SHACK, PAUL E. (JSC-EA42) (NASA); KOWAL, T. J. (JOHN) (JSC-ES3) (NASA); SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA)
Subject: RE: STS-107 Post-Launch Film Review - Day 1

This is, certainly, the largest one I have seen hit the Orbiter. The size and density of the debris cloud tells me that the hit is probably large in surface area but shallow. In the other two more significant hits I remember, the debris clouds were both narrow and "dense" (more resembling a con-trail). When the Orbiters came back, the hits were narrow, long, and deep. At what time or altitude did this occurred?

C

-----Original Message-----
From: SHACK, PAUL E. (JSC-EA42) (NASA)
Sent: Monday, January 27, 2003 8:56 AM
To: ORTIZ-LONGO, CARLOS R., PHD (JSC-EA4) (NASA)
Subject: FW: STS-107 Post-Launch Film Review - Day 1

top view

-----Original Message-----
From: SCHOMBURG, CALVIN (JSC-EA) (NASA)
Sent: Tuesday, January 21, 2003 9:26 AM
To: SHACK, PAUL E. (JSC-EA42) (NASA); SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA); HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA)
Subject: FW: STS-107 Post-Launch Film Review - Day 1

FYI-TPS took a hit-should not be a problem-status by end of week.

-----Original Message-----
From: Oliu-1, Armando [mailto:Armando.Oliu-1@nasa.gov]
Sent: Friday, January 17, 2003 6:08 PM
To: Abner, Charlie; ADAMS, RANDALL W. (JSC-MA2) (NASA); 'Ayotte, William'; Blue, John B; BROWN, KENNETH L. (JSC-MV6) (NASA); 'Buckingham, Bruce'; Bulloch-1, Steve; Bursian, Henry; BYRNE, GREGORY J., PHD (JSC-SX) (NASA); Chitko, Pete J.; 'cookjh@thiokol.com'; DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA); DISLER, JONATHAN M. (JON) (JSC-SX) (LM); DISLER, JONATHAN M. (JON) (JSC-SX) (LM); 'Eastwood Martin'; Estrada-1, Carlos; FRICKE, ROBERT W., JR (JSC-MV) (LM); GAETJENS, WILLIAM M. (JSC-CB) (USA); Glenn-1, Malcolm; GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA); 'GRP DOC Mission Support Room'; Guidi-1, John; Hawkins, Tyrell; Herman, Robert S; Herst, Terri; Holloway, Darrell L; 'Holmes Steve'; Huff, Joy N.; 'Jay.Sambamurthi@msfc.nasa.gov'; Jones-1, Frank; Kelley-1, David; 'Khodadoust, Abdollah'; Kienitz, Fred; 'Kinder Gerald'; 'Koenig Lisa'; 'Kopfinger, Philip A'; Lafleur, Tom C; Leggett, Kenneth D; Leinbach-1, Mike; HAM, LINDA J. (JSC-MA2) (NASA); 'Mango, Ed'; 'McClymonds, Jack'; MCCORMACK, DONALD L. (DON) (JSC-MV6) (NASA); Mosteller-1, Ted; Mulligan-1, Melanie; Nguyen-1, Bao; 'O'Farrell Mike'; ORTIZ-LONGO, CARLOS R., PHD (JSC-EA4) (NASA); 'Otte Neil'; 'Otto, Scott'; 'Page, Robert'; Payne-1, Michael; 'Ramirez, Juan'; Revay, Kenneth P; 'Rieckhoff, Tom - PC'; 'Rieckhoff, Tom - UNIX'; ROE, RALPH R. (JSC-MV) (NASA); SCHOMBURG, CALVIN (JSC-EA) (NASA); 'Schricker, B.'; 'nichols@hq.nasa.gov'; Sofge, Al (NASA HQ); 'Speece, Robert'; Stevenson-1, Charlie; 'Stone, Jeff'; Tenbusch-1, Ken; Wells-1, Joel; Wilson, Thomas F.; Rivera, Jorge; Greenwell-1, Shawn; Oliu-1, Armando; Crisafulli, Anthony; Brewer, Raymond J; Marren, Tom; Thompson-1, Becky

J.; Key, John; Lorick, Vicky K; Champagne, Lorraine C; Kent, William T. "Tim"; Spaulding-1, Jeff; Altemus-1, Steve; Mullins, Michael B; Powell, Doug; Cross, Donald G; Hammel-1, Donald; Stoner-1, Michael D; Greby, Mark J
ıbject: STS-107 Post-Launch Film Review - Day 1

Attached is the Day 1 report and an MPG of Anomaly #1.

<<107film1.pdf>> <<E212.mpg>>

Michele Lewis

From: SHACK, PAUL E. (JSC-EA42) (NASA)
Sent: Monday, January 27, 2003 1:31 PM
To: KOWAL, T. J. (JOHN) (JSC-ES3) (NASA); ORTIZ-LONGO, CARLOS R., PHD (JSC-EA4) (NASA); SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA)
Subject: RE: STS-107 Post-Launch Film Review - Day 1

82 seconds, Mach 2.6. The foam density is 2._ lb/ft^3; supposedly not a threat to RCC per Calvin and Curry.

-----Original Message-----
From: KOWAL, T. J. (JOHN) (JSC-ES3) (NASA)
Sent: Monday, January 27, 2003 12:04 PM
To: ORTIZ-LONGO, CARLOS R., PHD (JSC-EA4) (NASA); SHACK, PAUL E. (JSC-EA42) (NASA); SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA)
Subject: RE: STS-107 Post-Launch Film Review - Day 1

All I've heard is Mach 2.5.

John Kowal
ES3/Thermal Branch
NASA-Johnson Space Center
(281) 483-8871

-----Original Message-----
From: ORTIZ-LONGO, CARLOS R., PHD (JSC-EA4) (NASA)
Sent: Monday, January 27, 2003 11:48 AM
To: SHACK, PAUL E. (JSC-EA42) (NASA); KOWAL, T. J. (JOHN) (JSC-ES3) (NASA); SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA)
Subject: RE: STS-107 Post-Launch Film Review - Day 1

This is, certainly, the largest one I have seen hit the Orbiter. The size and density of the debris cloud tells me that the hit is probably large in surface area but shallow. In the other two more significant hits I remember, the debris clouds were both narrow and "dense" (more resembling a con-trail). When the Orbiters came back, the hits were narrow, long, and deep. At what time or altitude did this occurred?

C

-----Original Message-----
From: SHACK, PAUL E. (JSC-EA42) (NASA)
Sent: Monday, January 27, 2003 8:56 AM
To: ORTIZ-LONGO, CARLOS R., PHD (JSC-EA4) (NASA)
Subject: FW: STS-107 Post-Launch Film Review - Day 1

top view

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Sent: Tuesday, January 21, 2003 9:26 AM
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Sent: Friday, January 17, 2003 6:08 PM
To: Abner, Charlie; ADAMS, RANDALL W. (JSC-MA2) (NASA); 'Ayotte, William'; Blue, John B; BROWN, KENNETH L. (JSC-MV6) (NASA); 'Buckingham, Bruce'; Bulloch-1, Steve; Bursian, Henry; BYRNE, GREGORY J., PHD (JSC-SX) (NASA); Chitko, Pete J.; 'cookjh@thiokol.com'; DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA); DISLER, JONATHAN M. (JON) (JSC-SX) (LM); DISLER, JONATHAN M. (JON) (JSC-SX) (LM); 'Eastwood Martin'; Estrada-1, Carlos; FRICKE, ROBERT W., JR (JSC-MV) (LM); GAETJENS, WILLIAM M. (JSC-CB) (USA); Glenn-1, Malcolm; GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA); 'GRP DOC Mission Support Room'; Guidi-1, John; Hawkins, Tyrell; Herman, Robert S; Herst, Terri; Holloway, Darrell L; 'Holmes Steve'; Huff, Joy N.; 'Jay.Sambamurthi@msfc.nasa.gov'; Jones-1, Frank; Kelley-1, David; 'Khodadoust, Abdollah'; Kienitz, Fred; 'Kinder Gerald'; 'Koenig Lisa'; 'Kopfinger, Philip A'; Lafleur, Tom C; Leggett, Kenneth D; Leinbach-1, Mike; HAM, LINDA J. (JSC-MA2) (NASA); 'Mango, Ed'; 'McClymonds, Jack'; MCCORMACK, DONALD L. (DON) (JSC-MV6) (NASA); Mosteller-1, Ted; Mulligan-1, Melanie; Nguyen-1, Bao; 'O'Farrell Mike'; ORTIZ-LONGO, CARLOS R., PHD (JSC-EA4) (NASA); 'Otte Neil'; 'Otto, Scott'; 'Page, Robert'; Payne-1, Michael; 'Ramirez, Juan'; Revay, Kenneth P; 'Rieckhoff, Tom - PC'; 'Rieckhoff, Tom - UNIX'; ROE, RALPH R. (JSC-MV) (NASA); SCHOMBURG, CALVIN (JSC-EA) (NASA); 'Schricker, B.'; 'snichols@hq.nasa.gov'; Sofge, Al (NASA HQ); 'Speece, Robert'; Stevenson-1, Charlie; 'Stone, Jeff'; Tenbusch-1, Ken; Wells-1, Joel; Wilson, Thomas F.; Rivera, Jorge; Greenwell-1, Shawn; Oliu-1, Armando; Crisafulli, Anthony; Brewer, Raymond J; Marren, Tom; Thompson-1, Becky J.; Key, John; Lorick, Vicky K; Champagne, Lorraine C; Kent, William T. "Tim"; Spaulding-1, Jeff; Altemus-1, Steve; Mullins, Michael B; Powell, Doug; Cross, Donald G; Hammel-1, Donald; Stoner-1, Michael D; Greby, Mark J
Subject: STS-107 Post-Launch Film Review - Day 1

Attached is the Day 1 report and an MPG of Anomaly #1.

<<107film1.pdf>> <<E212.mpg>>

Michele Lewis

From: CAMPBELL, CARLISLE C., JR (JSC-ES2) (NASA)
Sent: Monday, January 27, 2003 5:00 PM
To: 'Bob Daugherty'
Subject: FW: Video you sent

Thanks. That's why they need to get all the facts in early on--such as look at impact damage from the spy telescope. Even then, we may not know the real effect of the damage.

The LaRC ditching model tests 20 some years ago showed that the Orbiter was the best ditching shape that they had ever tested, of many. But, our structures people have said that if we ditch we would blow such big holes in the lower panels that the orbiter might break up. Anyway, they refuse to even consider water ditching any more--I still have the test results[Bailout seems best.

From: Robert H. Daugherty [mailto:robert.h.daugherty@nasa.gov]
Sent: Monday, January 27, 2003 3:35 PM
To: CAMPBELL, CARLISLE C., JR (JSC-ES2) (NASA)
Subject: Video you sent

WOW!!!
I bet there are a few pucker strings pulled tight around there!
Thinking about a belly landing versus bailout..... (I would say that if there is a question about main gear well burn thru that its crazy to even hit the deploy gear button...the reason being that you might have failed the wheels since they are aluminum..they will fail before the tire heating/pressure makes them fail..and you will send debris all over the wheel well making it a possibility that the gear would not even deploy due to ancillary damage...300 feet is the wrong altitude to find out you have one gear down and the other not down...you're dead in that case)
Think about the pitch-down moment for a belly landing when hitting not the main gear but the trailing edge of the wing or body flap when landing gear up...even if you come in fast and at slightly less pitch attitude...the nose slapdown with that pitching moment arm seems to me to be pretty scary...so much so that I would bail out before I would let a loved one land like that.
My two cents.
See ya,
Bob

At 03:04 PM 1/27/2003, you wrote:

-----Original Message-----
From: SMITH, JAMES P. (JSC-ES2) (NASA)
Sent: Wednesday, January 22, 2003 7:15 AM
To: DL ES2 Branch; DL ES2 Contractors
Subject: FW: STS-107 Post-Launch Film Review - Day 1

Watch the video first and see if you can spot anything.

Michele Lewis

From: SHACK, PAUL E. (JSC-EA42) (NASA)
Sent: Wednesday, January 22, 2003 12:45 PM
To: ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA); HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA); MILLER, GLENN J. (JSC-EA) (NASA)
Cc: SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA); ROGERS, JOSEPH E. (JOE) (JSC-ES2) (NASA); GALBREATH, GREGORY F. (GREG) (JSC-ES2) (NASA)
Subject: RE: STS-107 Wing Debris Impact, Request for Outside Photo-Imaging Help

FYI - According to the MER, Ralph Roe has told the program that Orbiter is not requesting any outside imaging help

-----Original Message-----
From: ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)
Sent: Tuesday, January 21, 2003 4:41 PM
To: SHACK, PAUL E. (JSC-EA42) (NASA); HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA); MILLER, GLENN J. (JSC-EA) (NASA)
Cc: SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA); ROGERS, JOSEPH E. (JOE) (JSC-ES2) (NASA); GALBREATH, GREGORY F. (GREG) (JSC-ES2) (NASA)
Subject: STS-107 Wing Debris Impact, Request for Outside Photo-Imaging Help

Paul and Dave,
The meeting participants (Boeing, USA, NASA ES2 and ES3, KSC) all agreed we will always have big uncertainties in any transport/trajectory analyses and applicability/extrapolation of the old Arc-Jet test data until we get definitive, better, clearer photos of the wing and body underside. Without better images it will be very difficult to even bound the problem and initialize thermal, trajectory, and structural analyses. Their answers may have a wide spread ranging from acceptable to not-acceptable to horrible, and no way to reduce uncertainty. Thus, giving MOD options for entry will be very difficult.*

Can we petition (beg) for outside agency assistance? We are asking for Frank Benz with Ralph Roe or Ron Dittemore to ask for such. Some of the old timers here remember we got such help in the early 1980's when we had missing tile concerns.

*Despite some nay-sayers, there are some options for the team to talk about: On-orbit thermal conditioning for the major structure (but is in contradiction with tire pressure temp. cold limits), limiting high cross-range de-orbit entries, constraining right or left had turns during the Heading Alignment Circle (only if there is struc. damage to the RCC panels to the extent it affects flight control.

Rodney Rocha
Structural Engineering Division (ES-SED)
- **ES Div. Chief Engineer (Space Shuttle DCE)**
- **Chair, Space Shuttle Loads & Dynamics Panel**

Mail Code ES2 Phone 281-483-8889

Michele Lewis

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- **ES Div. Chief Engineer (Space Shuttle DCE)**
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Mail Code ES2 Phone 281-483-8889

Michele Lewis

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Sent: Tuesday, January 21, 2003 5:41 PM
To: SHACK, PAUL E. (JSC-EA42) (NASA); HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA); MILLER, GLENN J. (JSC-EA) (NASA)
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Rodney Rocha
Structural Engineering Division (ES-SED)
ES Div. Chief Engineer (Space Shuttle DCE)
- **Chair, Space Shuttle Loads & Dynamics Panel**

Mail Code ES2 Phone 281-483-8889

The Boeing/USA team would like to meet with you Tuesday at 2:00 on meet-me-line number [redacted] to discuss analysis plans for assessing the STS-107 Debris Impact.

Pam Madera
Vehicle and Systems Analysis Subsystem Area Manager
Phone: 281-282-4453

Michele Lewis

From: Oliu-1, Armando [Armando.Oliu-1@nasa.gov]
Sent: Thursday, January 16, 2003 3:34 PM
To: Abner, Charlie; ADAMS, RANDALL W. (JSC-MA2) (NASA); 'Ayotte, William'; Blue, John B; BROWN, KENNETH L. (JSC-MV6) (NASA); 'Buckingham, Bruce'; Bulloch-1, Steve; Bursian, Henry; BYRNE, GREGORY J., PHD (JSC-SX) (NASA); Chitko, Pete J.; 'cookjh@thiokol.com'; DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA); DISLER, JONATHAN M. (JON) (JSC-SX) (LM); DISLER, JONATHAN M. (JON) (JSC-SX) (LM); 'Eastwood Martin'; Estrada-1, Carlos; FRICKE, ROBERT W., JR (JSC-MV) (LM); GAETJENS, WILLIAM M. (JSC-CB) (USA); Glenn-1, Malcolm; GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA); 'GRP DOC Mission Support Room'; Guidi-1, John; Hawkins, Tyrell; Herman, Robert S; Herst, Terri; Holloway, Darrell L; 'Holmes Steve'; Huff, Joy N.; 'Jay.Sambamurthi@msfc.nasa.gov'; Jones-1, Frank; Kelley-1, David; 'Khodadoust, Abdollah'; Kienitz, Fred; 'Kinder Gerald'; 'Koenig Lisa'; 'Kopfinger, Philip A'; Lafleur, Tom C; Leggett, Kenneth D; Leinbach-1, Mike; HAM, LINDA J. (JSC-MA2) (NASA); 'Mango, Ed'; 'McClymonds, Jack'; MCCORMACK, DONALD L. (DON) (JSC-MV6) (NASA); Mosteller-1, Ted; Mulligan-1, Melanie; Nguyen-1, Bao; 'O'Farrell Mike'; ORTIZ-LONGO, CARLOS R., PHD (JSC-EA4) (NASA); 'Otte Neil'; 'Otto, Scott'; 'Page, Robert'; Payne-1, Michael; 'Ramirez, Juan'; Revay, Kenneth P; 'Rieckhoff, Tom - PC'; 'Rieckhoff, Tom - UNIX'; ROE, RALPH R. (JSC-MV) (NASA); SCHOMBURG, CALVIN (JSC-EA) (NASA); 'Schricker, B.'; 'snichols@hq.nasa.gov'; Sofge, Al (NASA HQ); 'Speece, Robert'; Stevenson-1, Charlie; 'Stone, Jeff'; Tenbusch-1, Ken; Wells-1, Joel; Wilson, Thomas F.; Rivera, Jorge; Greenwell-1, Shawn; Oliu-1, Armando; Crisafulli, Anthony; Brewer, Raymond J; Marren, Tom; Thompson-1, Becky J.; Key, John; Lorick, Vicky K; Champagne, Lorraine C; Kent, William T. "Tim"; Spaulding-1, Jeff; Altemus-1, Steve; Mullins, Michael B; Powell, Doug; Cross, Donald G
Subject: STS-107 Post-Launch Video Review and Post-Launch MLP/Pad Inspection


J7video-launch.pdf 107mlp.pdf

<<107video-launch.pdf>> <<107mlp.pdf>>

Michele Lewis

From: Oliu-1, Armando [Armando.Oliu-1@nasa.gov]
Sent: Wednesday, January 15, 2003 1:52 PM
To: Abner, Charlie; ADAMS, RANDALL W. (JSC-MA2) (NASA); 'Atkinson, Bill C.'; 'Ayotte, William'; Blue, John B; BROWN, KENNETH L. (JSC-MV6) (NASA); 'Buckingham, Bruce'; Bulloch-1, Steve; Bursian, Henry; BYRNE, GREGORY J., PHD (JSC-SX) (NASA); Chitko, Pete J.; 'cookjh@thiokol.com'; DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA); DISLER, JONATHAN M. (JON) (JSC-SX) (LM); DISLER, JONATHAN M. (JON) (JSC-SX) (LM); 'Eastwood Martin'; Estrada-1, Carlos; FRICKE, ROBERT W., JR (JSC-MV) (LM); GAETJENS, WILLIAM M. (JSC-CB) (USA); Glenn-1, Malcolm; GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA); 'GRP DOC Mission Support Room'; Guidi-1, John; Hawkins, Tyrell; Herman, Robert S; Herst, Terri; Holloway, Darrell L; 'Holmes Steve'; Huff, Joy N.; 'Jay.Sambamurthi@msfc.nasa.gov'; Jones-1, Frank; Kelley-1, David; 'Khodadoust, Abdollah'; Kienitz, Fred; 'Kinder Gerald'; 'Koenig Lisa'; 'Kopfinger, Philip A'; Lafleur, Tom C; 'Lee Michael'; Leggett, Kenneth D; Leinbach-1, Mike; HAM, LINDA J. (JSC-MA2) (NASA); 'Mango, Ed'; 'McClymonds, Jack'; MCCORMACK, DONALD L. (DON) (JSC-MV6) (NASA); Mosteller-1, Ted; 'Mulholland John'; Mulligan-1, Melanie; Nguyen-1, Bao; 'O'Farrell Mike'; ORTIZ-LONGO, CARLOS R., PHD (JSC-EA4) (NASA); 'Otte Neil'; 'Otto, Scott'; 'Page, Robert'; Payne-1, Michael; 'Ramirez, Juan'; Revay, Kenneth P; 'Rieckhoff, Tom - PC'; 'Rieckhoff, Tom - UNIX'; 'Robertson, James M.'; ROE, RALPH R. (JSC-MV) (NASA); SCHOMBURG, CALVIN (JSC-EA) (NASA); 'Schricker, B.'; 'snichols@hq.nasa.gov'; Sofge, Al (NASA HQ); 'Speece, Robert'; Stevenson-1, Charlie; 'Stone, Jeff'; Tenbusch-1, Ken; Wells-1, Joel; Wilson, Thomas F.; Rivera, Jorge; Greenwell-1, Shawn; Oliu-1, Armando; Crisafulli, Anthony; Brewer, Raymond J; Marren, Tom; Thompson-1, Becky J.; Key, John; Lorick, Vicky K; Champagne, Lorraine C; Kent, William T. "Tim"; Spaulding-1, Jeff; Altemus-1, Steve; Mullins, Michael B; Powell, Doug
Subject: STS-107 Ice/Debris Team Pre-Launch Inspection

107preLaunch.pdf

Michele Lewis

From: BROWN, KENNETH L. (JSC-MV6) (NASA)
Sent: Sunday, January 19, 2003 6:26 PM
To: SHACK, PAUL E. (JSC-EA42) (NASA)
Subject: RE: Impact Damage Reports


STS-107 Launch Film Re


STS-107 Launch Film


STS-107 Long Range Tracking


JSC STS-107 Vinch Video Scre


STS-107 Launch Video


STS-107 Ice/ Rois Team Pre-L

-----Original Message-----
From: SHACK, PAUL E. (JSC-EA42) (NASA)
Sent: Sunday, January 19, 2003 5:22 PM
To: MCCORMACK, DONALD L. (DON) (JSC-MV6) (NASA); BROWN, KENNETH L. (JSC-MV6) (NASA)
Subject: Impact Damage Reports

If you guys have anything info on the debris impact assessment, would you please forwad. Thanks

Michele Lewis

From: Madera, Pamela L [pam.l.madera@usahq.unitedspacealliance.com]
Sent: Friday, January 17, 2003 4:44 PM
To: ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)
Subject: RE: STS-107 Long Range Tracking Video Screening

Pam Madera
Vehicle and Systems Analysis Subsystem Area Manager
Phone: 281-282-4453

-----Original Message-----
From: Madera, Pamela L
Sent: Friday, January 17, 2003 2:46 PM
To: ROCHA, ALAN RODNEY
Subject: FW: STS-107 Long Range Tracking Video Screening

Rodney,
Wanted to make sure you have heard about this. Mike is talking to his group to see what they can do parametrically. Dennis Chao is in contact with Carlos Ortiz/Boeing SI Aero to see if they will be turning on an assessment of the impact. More to come.

Pam Madera
Vehicle and Systems Analysis Subsystem Area Manager
Phone: 281-282-4453

-----Original Message-----
From: Madera, Pamela L
Sent: Friday, January 17, 2003 1:43 PM
To: Norman Ignacio (Nacho) (E-mail); CHAO, DENNIS
Cc: Michael J Dunham (E-mail); ALEXANDER, ED
Subject: FW: STS-107 Long Range Tracking Video Screening

We may be getting questions on the following report. I looked at the video on the web site (note that the URL wraps around and you have to copy and paste the end of it), but I find it hard to see where the impact is. Looks like they will be reviewing more film over the weekend.

Pam Madera

Vehicle and Systems Analysis Subsystem Area Manager
Phone: 281-282-4453

-----Original Message-----
From: DISLER, JONATHAN M. (JON) (JSC-SX) (LM)
[mailto:jonathan.m.disler1@jsc.nasa.gov]
Sent: Friday, January 17, 2003 12:56 PM
To: Armando Oliu (E-mail); BAHR, PATRICIA A. (PAT) (JSC-SJ) (NASA); BARBARA A. CONTE (JSC-DM) (E-mail); Bill Lamkin; BOBBIE G. SWAN (JSC-CA) (E-mail); Brenda Eliason; BRIAN K. BALU (JSC-NC) (E-mail); Carlos Ortiz-Longo; Chris "The Man" Cloudt; Chris Hadfield (E-mail); Chris Lessmann; Christine Boykin; Curt Larsen / MS2; Dan Clements / NC-GH2; David Brown / CB (STS-107); David Moyer / MER Manager (E-mail); DAVID R. BRETZ (JSC-SN) (E-mail); David Rigby / MPS SSM (E-mail); DENA S. HAYNES (JSC-EV) (E-mail); Don Prevett; DONALD L. (DON) MCCORMACK (JSC-MV) (E-mail); Doug White; Douglas Powell (MAF); FRED F. MAYER (JSC-NC) (E-mail); Gail Hargrove Boeing-Houston Imagery Scrn.; Greg Katnik; Gregory Galbreath; GREGORY J. BYRNE (JSC-SN3) (E-mail); JAMES B. (BRITT) WALTERS (JSC-SF2) (E-mail); 'James Feeley' (E-mail); James Walters; JAVIER J. JIMENEZ (JSC-EA) (E-mail); Jeff Goodmark (E-mail); Jene Richart / MS2; Jill Lin; Jim Harder; 'John McKee' (E-mail); John Ventimiglia; JONATHAN M. (JON) DISLER (JSC-SN) (E-mail); Jorge Rivera; Julie Kramer; Karen Alfaro (E-mail); KENNETH L. BROWN (JSC-MV) (E-mail); KEVIN L. CROSBY (JSC-SN) (E-mail); 'L Lohrli' (E-mail); Malcolm Glenn; MARK D. ERMINGER (JSC-NC) (E-mail); Mark Erminger; MARK L. HOLDERMAN (JSC-MS) (E-mail); MARSHA S. IVINS (JSC-CB) (E-mail); MARTINEZ, HUGO E. (JSC-NC) (GHG); Michael Anderson / CB (STS-107); MICHAEL W. SNYDER (JSC-SN) (E-mail); Mike Cagle / Boeing Film Screen; Mike O'farrell; P J. (JEFF) BERTSCH (JSC-DD) (E-mail); Pam Madera (E-mail); PAUL F. DYE (JSC-DA8) (E-mail); PAYNE, ROBERT W. (JSC-SA13) (LM); 'Philip Kopfinger' (E-mail); Philip Peterson / Boeing Film Screen (E-mail); Philip Reid / Boeing Film Screen; PREMKUMAR SAGANTI PhD (JSC-SN) (E-mail); RANDALL W. ADAMS (JSC-MS2) (E-mail); RAYMOND T. (RAY) SILVESTRI (JSC-DM4) (E-mail); Rick Husband / CB (STS-107); Robbie Robbinson; Robert Page; ROBERT SCHARF (JSC-SN) (E-mail); Robert Speece; ROBERT W. FRICKE JR (JSC-MV) (E-mail); Rodney Rocha / ES2 (E-mail); Rodney Wallace; Rohit Dhawan; Ronald Clayton / MS2; Roy Glanville; Rudy Ramon; SA REP; Sara Brandenburg; Scott Otto; Stephen Frick / CB; Steve Derry; Tom Rieckhoff; Tom Wilson; 'Treith' (E-mail)
Subject: STS-107 Long Range Tracking Video Screening

JSC STS-107 Launch Screening - Long Range Tracking Videos

January 17, 2003

JSC Image Science and Analysis Group Human Exploration Science Office / SX

ANOMALY

ET204, ET208, ET212 - During ascent at approximately 81 seconds MET, a large light-colored piece of debris was seen to originate from an area near the ET/Orbiter forward attach bipod. The debris appeared to move outboard in a -Y direction, then fell aft along the left Orbiter fuselage, and struck the leading edge of the left wing. The strike appears to have occurred on or relatively close to the wing glove near the Orbiter fuselage. After striking the left wing the debris broke into a spray of white-colored particles that fell aft along the underside (-Z side) of the Orbiter left wing. The spray of particles was last seen near the LSRB exhaust plume.

Still views and a movie loop of this event are being placed on our web site for viewing at the following address:

<http://sn-isag.jsc.nasa.gov/shuttleweb/mission_support/sts-107/launch_video/107launchvideo.shtml>

The times of this event are as follows:

Debris first seen near ET/Orbiter forward attach: 016:15:40:21.699 UTC
Debris contacted left wing:
016:15:40:21.882 UTC

Screening of the high speed and high resolution long range tracking films that may show more detail of this event will begin on Saturday morning, January 18th.

Normal Observations Noted Included:

Vapor off the SRB stiffener rings, recirculation, SRB plume brightening, and slag debris after SRB separation.

NOTES:

The long range video tracking views had very soft focus possibly due to clouds and haze.

SRB separation occurred at approximately 016:15:41:06.558 UTC as seen on camera ET208.

Five long range tracking videos were received and screened. Timing data was received on all of the videos received except ET207.

The launch film screening will be conducted on Saturday and Sunday and a report will be sent to distribution on Monday, January 20, 2003.

Jon Disler / SX3-LM
Joe Caruana / SX3-LM
Eric Nielsen / SX3-HEI